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Juveniles of *Plethodon jordani* Blatchley

By JOHN THORNTON WOOD

This report is the first published descriptive comparison of the proportions, size, color, and pattern of juvenile and adult *Plethodon jordani*. The tiny specimens mentioned by Bailey, Bishop, and King are larger than the largest juvenile studied in this report, and apparently the only juvenile any herpetologist has seen which falls into this size group was examined by Dunn in the Mt. Sterling area of North Carolina.

In May, 1946, 29 juveniles were collected in an area 50 feet in diameter in the heavy Spruce-Fir forest on Indian Gap, Great Smoky Mountains National Park, at elevation 5,100 feet on the Tennessee side. All specimens were taken between May 6th and 25th. Although the exact site of Blatchley's collecting remains in doubt, these specimens may be considered topotypes.

King reported the species most abundant in locations where the forest floor consisted of a heavy layer of moss over thin soil on rocks. The habitat I examined was free of all ground vegetation, the slope showing many flat rocks protruding through the thick bed of fallen needles. Half of the juveniles were collected beneath flat rocks, the remainder being found under rotten logs and bark on the forest floor.

Coloration

Bishop reported that a 29 mm. juvenile he examined (tip of tail missing) was colored like adults. This specimen with complete tail would have been larger than my largest juvenile, and none of my juveniles were colored like adults. The distinguishing mark of the adult Red-Cheeked salamander is its red cheek, which is white in all juveniles. At most only a faint pink line is present along the dorsal margin of the white-cheek patch. In all other respects the juveniles were colored like adults.

Pattern

Bailey observed two small *Plethodon jordani* (snout to vent 22.3 and 24.0 mm.) which had faint dorsal areas suggestive of juvenile dorsal spots. The total length of his specimens would have been 35 to 40 mm. I found that 5 specimens of the 10 I examined whose lengths ranged from 37.6 to 48.5 mm. had distinguishable red dorsal trunk markings, a pattern not observed in the several hundred full-sized adults examined. These dorsal red areas are more pronounced on the smaller specimens.

Plethodon jordani, juvenile

All 29 juveniles had red dorsal areas. Under a binocular microscope these areas appeared to consist of varying densities of irregular red flecks, and when red pigment was concentrated, a clear-cut red spot was apparent. Half of the specimens had head markings, 90% had trunk markings, but only a single specimen showed red flecks on its tail.

Type of Markings	*Head*	*Trunk*
1. Fleck bands	41.4%	31.0%
2. Isolated fleck groups	10.2%	27.6%
3. Dorsal spots	.....	31.0%
4. No markings	48.4%	10.4%

The above table shows the proportion of juveniles in which the different types of markings appeared. Fleck bands on the head were composed of tiny red flecks arising in a band at the posterior of the eye, and converging at the neck to form a "Y", whereas on the body the flecks formed parallel rows about 0.5 mm. apart, on either side of the vertebral column. On the body the flecks diminished in number posteriorly so that the distal half of the trunk was usually immaculate. Isolated fleck groups were composed of large clumpings of flecks (1.0 - 2.0 mm. diameter) scattered at random on the anterior half of the dorsal trunk area, or posteriorly on the head. Dorsal spots were clear red areas located without any definite pattern, as in the case of isolated fleck groups. No regular paired dorsal spots were found. Of those juveniles having red spots, the average number of spots per specimen was 4.

Size and Proportions

The 29 juveniles studied in this report ranged in total length between 22.5 and 28.9 mm. semi-interquartile range 24.1 to 27.3 mm. Averaged measurement based on 27 juveniles with complete tails, as follows: Total length 25.6 mm. (head 5.1, body 10.5, tail 10.0).

Comparison of body proportions with adults listed by Bishop: (% of total length):

	Male (119 mm.)	*Female* (135 mm.)	*Juvenile* (25.6 mm.)
Head length	11.7%	13.3%	19.9%
Body length	37.5%	38.5%	41.0%
Tail length	50.8%	48.2%	39.1%

Acknowledgements

I am indebted to Park Naturalist Arthur Stupka, who made this study possible. (The herpetofaunal study collection in park headquarters was donated 20 of the specimens on which this report is based.) Collecting assistants: R. L. Kathe, D. R. Peterson, and J. D. Murray. The accurate ink drawing was prepared by H. J. Walthers, Ohio State University, Columbus, Ohio.

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ANTIOCH COLLEGE, YELLOW SPRINGS, OHIO

Description of Juvenile *Plethodon glutinosus shermani* Stejneger

By JOHN THORNTON WOOD

This observation is based on a juvenile *Plethodon glutinosus shermani* collected by Mr. J. D. Murray May 30, 1946, on Wayah Bald, Nantahala National Forest, North Carolina at 4,300 feet elevation, and is the first published report contrasting the differences in color, pattern, and proportions between adults and juveniles of this species.. During intensive collecting of an area 50 yards in diameter in a maple and birch forest 40 adults were found, but only a single juvenile.

Using Bishop's measurements for typical adult male and female specimens, a comparison with juvenile proportions is as follows:

	Total Length	*Head Length*	*Body Length*	*Tail Length*
Adult male	115 mm.	15 mm.	43 mm.	57 mm.
	100 %	13.0 %	37.4 %	49.6 %
Adult female	128 mm.	15 mm.	45 mm.	68 mm.
	100 %	11.7 %	37.4 %	49.6 %
Juvenile	26.5 mm.	4.5 mm.	11.8 mm.	10.2 mm.
	100 %	17.0 %	44.5 %	38.5 %

The juvenile specimen shows the same black dorsal pigmentation as the typical adults described by Bishop, but the red markings on the dorsal surfaces of the limbs are absent. Instead, an unpigmented irregular white area is present which corresponds to the typical red marking on adult limbs, and a faint pink line borders the juvenile white area of the legs.

The juvenile pattern differs from the adult in the presence of unpaired irregular red dorsal spots on the anterior third of the trunk. Four of these spots, having diameters of 0.3 to 1.0 mm. were present, while the dorsal trunk areas of 40 adults examined were unmarked black.

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ANTIOCH COLLEGE, YELLOW SPRINGS, OHIO

A Snake "Den" Tree on Guadalcanal Island

By ROBERT C. PENDLETON

On December 26, 1943, a snake *(Boiga irregularis)* was collected which had been killed as it was trying to escape from a hole in the upper branches of a hollow tree in the open bottom of which a fire had been started by a group of soldiers. Having been attracted by the excitement of the soldiers, the writer reached the tree in time to salvage the dead snake for identification and to count six snakes of the same type as they escaped into the branches of nearby trees. The soldiers had seen eight others, including the one that had been knocked from the tree by a thrown stick. All told, fourteen snakes were driven from the tree, seven of which were definitely *Boiga irregularis*. It is probable that the entire group were of this type.

Near the same tree on January 24, 1944, another specimen of the same species was taken from shrubbery near the hollow den tree which had not been seriously damaged by the fire. This last snake was taken late in the evening.

THE "DEN" TREE

This hollow tree is on the east bank of the Little Tenaru river, a tributary of the Tenaru, about two miles inland. It is a species of *Barringtonia* and leans over the stream at a slight angle. The upper branches are interwoven with other trees. The lower entrance to the hollow interior opens at the soil line and is about three feet in height by eighteen inches at its widest point. The other openings are apparently places where branches have broken off the dead side, and are over fifteen feet from the ground.

THE ROLE OF A "DEN" IN THE TROPICS

This hollow tree cannot be considered as a den if the connotation of seasonal hibernation is to be attached, but it can definitely be shown to serve as protection from the rigors of a tropical environment, and is probably a site for daily aestivation. *Boiga irregularis* is a nocturnal snake as evidenced by the eliptical pupil of the eye, its presence in a hollow tree in the middle of the day, and personal observation of one that was killed by a hospital corpsman at U. S. Navy Fleet Hospital 108 as it was entering an operating room at night.

A brief consideration of the weather conditions on the portion of Guadalcanal where the den tree was found gives additional reasons for reptiles to seek a spot where the full impact of the climate can be avoided or modified. The seasons vary from one of extreme drought during which some streams dry up with the exception of small, disconnected pools, to a season of deluge during which rain may fall with only short periods of respite for several days, during which time streams overflow their banks.

Daily fluctuations of air temperature shown by U. S. army air forces records range from 67° to 94° F., but higher and lower temperatures have been infrequently noted (personal observations). The low temperatures are not a problem, but the heat of the midday sun would soon kill

any snake left in it without shelter. It has been shown (Cowles and Bogert, 1944, p. 276) that ground temperatures usually exceed air temperatures by 20° or more. Thus an air temperature of 100° F., which was noted occasionally in this area, would give a ground temperature of 120° or more which has been shown to be well above the lethal maximum for reptiles (Cole, 1943, p. 196). Avoidance of lethal or uncomfortable temperatures could easily account for the snakes congregating in such a refuge as offered by the tree.

A hollow tree of the type found would, besides providing shelter from the elements, afford protection from the hawks, and eagles, that have been observed hunting in the area. The upper openings were quite small and might serve to keep the big monitor lizard *(Varanus indicus)* out of the tree, or if pressed from within the snakes could escape through these holes leaving the lizard behind. That this large lizard is capable of handling prey as large as small snakes is shown by the writer's experience in taking from a stomach a full grown rat *(Rattus rattus* sp.).

This congregation of a single snake species in a place of comfort would indicate that this is an adaptation to meet the conditions of the climate, just as are similar denning habits of snakes in temperate climates.

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UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH

Range Extension of *Hyla septentrionalis* in Florida

By HAROLD TRAPIDO

On November 8, 1946, while collecting along the Florida Keys in company with Dr. and Mrs. Marston Bates, we overnighted at the southern end of Upper Matacumba Key. Our hosts told us of a tree frog which had been resident in their kitchen for some months, but were unable to show it to us. Stopping by the same locality on November 11th the frog was found on a kitchen shelf. It was an adult specimen of *Hyla septentrionalis*. As this species has previously only been reported in Florida from Key West (Carr, 1940, Univ. Fla. Pub., Biol. Sci. Ser., vol. 3, no. 1) this is a northward range extension of some 80 miles. The species also occurs on the boles of palm trees about two miles north of the lower end of Upper Matacumba Key, according to our hosts.

APARTADO 1252, PANAMA, R. de P.

The Hyobranchial Skeleton of Plethodontidae

By WILLIAM A. HILTON

One of the most characteristic amphibian groups of the New World is the salamander family Plethodontidae. It is in fact almost entirely confined to North and South America. A notable exception seems to be *Hydromantes genei* from Southern Europe.

The skeleton of the throat region is quite well known through the writings of the following: Cope, '87 and '89; Hilton, '09; Shith, '20; Edgeworth, '23; Piatt, '35. In spite of a clear idea of the adult apparatus, there are many gaps in our knowledge of the larval condition; for a complete understanding of relationships this information is important.

Throughout the tailed Amphibia there are great differences in various genera and species. In the larval condition the number of branchial arches seems important. In Salamandridae, Amphuimidae, Sirenidae, Cryptobranchidae, Hynobiidae and Amblystomidae as far as I know there are four pairs of branchial arches. Proteidae, Necturus and Proteus have three. In the Plethodontidae there are a number of genera where the larval conditions are not known. In this paper a number not before described are given, such as Leurognathus, Stereochilus, Hemidactylum, Manculus. Those as yet unknown are Hydromantes—at least in the American species, Batrachoseps, Ensatina, Aneides, Plethopsis and Plethodon in the United States area and all of the Mexican and Central American genera.

In all the genera of Plethodontidae examined, two only have four pairs of branchial arches, Desmognathus and Leurognathus. This may show that these are closely related and also suggest that they are more definitely related to other groups than the rest of the family so far known, for they all have the rather distinctive number of three pairs of branchial arches. Hemidactylum is closely related to the genus Plethodon but I have not yet had a young enough larva to this last genus to determine the number of gill bars.

In all larvae examined there is great similarity. The ceratohyals are usually short and associated with each of them at the forward end is the central first basibranchial. The second basibranchial ends in various ways, sometimes as a flat plate, sometimes as a point, sometimes it is forked. This condition shows on dorsal views. On the ventral side a slender median rod of variable length and thickness starts from the center of the first basibranchial.

In the adults of Leurognathus and Desmognathus there are two pairs of cornua attached to the upper part of the first basibranchial. In both of these genera the second basibranchial or os thyroideum is not triangular, but more or less curved or straight. I have seldom found any sign of a lingual cartilage in these genera. Lingual cartilages are not found in all

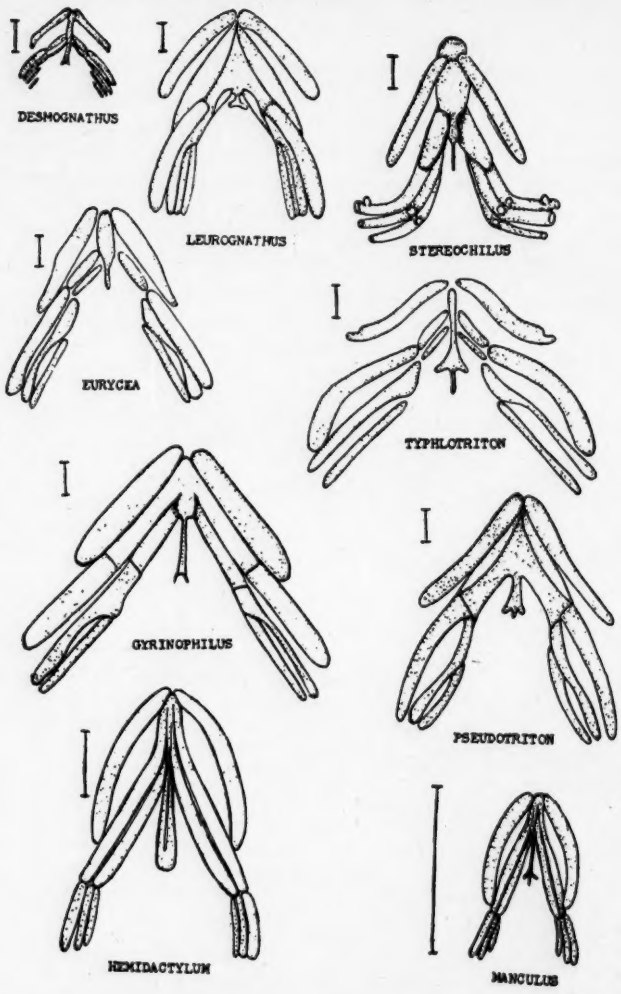

Figure 1. Diagrams of the Hyobranchial systems of various genera of Plethodontidae. The scale equals one mm. All are larvae.

genera, but at least they may be seen in Manculus, Eurycea, Gyrinophilus and Pseudotriton. In Plethodon the tip of the first basibranchial may represent this small part. The second basibranchial is always bone and usually three pointed, but it differs in genera, in species and in individuals.

Seven genera of Mexican and Central American salamanders of this family have much the same hyobranchial apparatus in the adult, all have well developed cornua and are also like the more northern Batrachoseps and Plethopsis with no os thyroideum. Hydromantes genei from Italy and H. platycephalus from California are like each other and much like these last except they do not have any cornua off from the basibranchial.

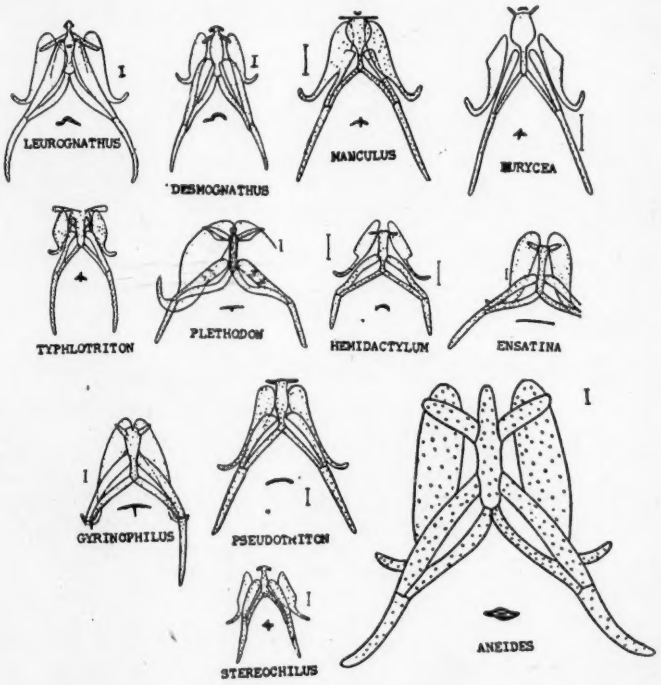

Figure 2. Diagrams of the Hyobranchial apparatus in adult Plethodontidae. The scales shown each represent one mm.

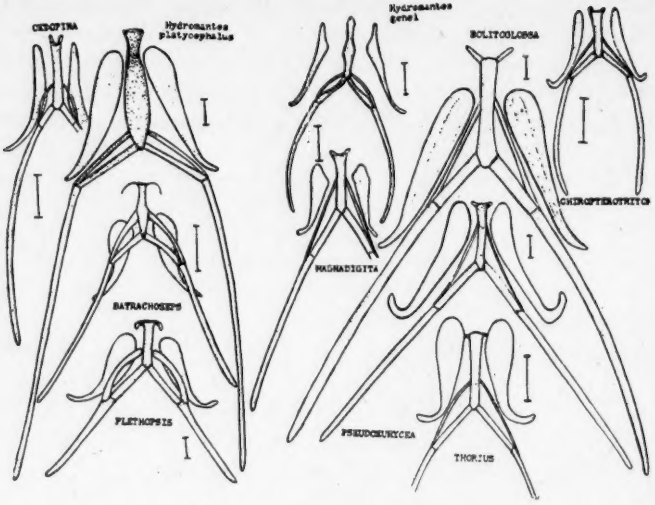

Figure 3. Diagrams of Mexican and Central American genera of Plethodontidae with also the North American genera *Batrachoseps, Plethopsis* and two species of *Hydromantes,* one from California and one from Italy. All are adults. The scales equal each one mm.

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POMONA COLLEGE, CALIFORNIA

An Annotated List of Herpetological Papers from the Proceedings of the Indiana Academy of Science

By DR. SHERMAN A. MINTON, JR.

The first meeting of the Indiana Academy of Science was held at Brookville, Indiana, in 1886. At that meeting, Dr. David Starr Jordan was elected president of the organization. At an early meeting, the position "Curator of Herpetology" was established and was first filled by Dr. Oliver P. Hay. Between the years 1886 and 1891, meetings of the academy were held and papers presented; but the first volume of the Proceedings was not published until the meeting in 1891. Most of the papers which were presented prior to that time seem to have survived only as titles. Excluding those listed by title only, forty-eight papers dealing with various aspects of herpetology are found in the Proceedings. Some were published only as abstracts, the complete papers appearing in other publications.

It is hoped that the publication of the following list of papers will aid in bringing little-known material to the attention of naturalists. The local lists will be of interest to taxonomists and others desirous of compiling locality records. The several papers dealing with reptile and amphibian anatomy and physiology will be useful not only to herpetologists but to students of other branches of vertebrate biology. In this synopsis, the taxonomic usage of the original article has been retained in all cases. The papers are listed in their chronological sequence.

1891. Hay, Oliver P.
On the breeding habits, eggs, and young of certain snakes. 1: 106-120.

A summary of reports relative to the reproductive habits of several species of snakes. Included are accounts of erroneous beliefs then prevalent even among naturalists. The following species are mentioned: *Agkistrodon contortrix, Agkistrodon piscivorus, Sistrurus catenatus, Eutainia* sp., *Tropidonotus* sp., *Storeria dekayi, Heterodon platyrhinos, Coluber obsoletus, Bascanion constrictor, Haldea striatula.*

Interesting data is given on fall mating in the copperhead; copulation between the black and spotted phases of *Heterodon*; and the presence of the egg tooth in ovoviviparous species.

1891. Hay, Oliver P.
Some observations on the turtles of the genus *Malaclemys*. 1: 120-126.

Reviews the points of differentiation between *M. geographica* and *M. pseudogeographica.* Feeding habits and secondary sexual characters are discussed.

1891. Hay, Oliver P.
Our present knowledge concerning the green triton, *Diemyctylus viridescens*. 1: 144-147.

Discussion of the aquatic and terrestrial forms of the newt. Possible importance of the red color of the eft as a warning signal.

1891. Bigney, Andrew J.
Notes on *Elaps fulvius*. 1: 151-152.
Reports a snake of this species taken near Milan, Ripley Co., Indiana.

1891. Owen, D. A.
Some observations on *Heloderma suspectum*. 1: 152-154.
An account of the feeding, skin shedding, and general behavior of a captive "gila monster." Attempts to demonstrate presence of venom. Rat died overnight after having been bitten three times.

1893. Butler, Amos W.
On the habits of turtles. 3: 224.
In the Whitewater River (Indiana), softshelled turtles seek deeper water for hibernation than do the hardshelled forms and have a longer period of hibernation.

1895. Atkinson, Curtis
Batrachia of Turkey Lake, India. 5: 258-261.
Annotated list of ten species including one species of toad, six species of frogs, and three species of salamanders.

1895. Reddick, George
Snakes of Turkey Lake, Indiana. 5: 261-262.
Records of eight species with notes and mention of a series of 72 embryos taken from a single female garter snake.

1895. Eigenmann, C. H.
Testudinae of Turkey Lake, Indiana. 5: 262-264.
Records of eight species with notes on their abundance and breeding habits.

1897. Bruner, Henry L.
Description of a new facial muscle in Anura with new observations on the nasal muscles of salamanders. (Abstract) 7: 203.
In salamanders, dialator and constrictor nasal muscles are always found. An accessory dialator muscle is seen in some forms. Because of their relation to the nasal gland, contraction of these muscles expresses mucoid secretion from the gland thus helping to seal the nares.
Dialator naris and constrictor naris muscles are present in Rana but are degenerate and their function modified. A new muscle, M. labialis superior, is described and is found in several genera of Anura.

1897. Bruner, Henry L.
A rare species of *Bascanion*. 7: 204-205.
Records a specimen of the racer, *Bascanion ornatum* (Baird & Girard) from near El Paso, Texas, and briefly discusses the affinities of this species.

1897. Bruner, Henry L.
On the heart of lungless salamanders. (Abstract) 7: 205.

The sinus atrium valve in these salamanders is not to be confused with a septum atriorum. The conus arteriosus in some forms shows a spiral fold.

1897. Woldt, Mae

The pulmonary arch of lungless salamanders. (Abstract) 7: 206.

In lungless salamanders, the pulmonary arterial arch persists in part and supplies blood to the skin and esophagus.

1898. Bruner, Henry L.

The distribution of blood sinuses in the reptilian head. (Abstract) 8: 228.

The principal blood sinuses in the reptile are: (1) the intracranial, (2) the nasal, and (3) the orbital.

1898. Bruner, Henry L.

On the regulation of the supply of blood to the venous sinuses of the head of reptiles and description of a new sphincter muscle on the jugular vein. (Abstract) 8: 229.

The remarkable development of the blood sinuses of the reptile head is associated with a sphincter muscle around the jugular vein which allows venous pressure to be raised periodically. This facilitates moulting of the skin of the head and in part explains the mechanism of blood ejection from the eye as seen in *Phrynosoma.*

1898. Eigenmann, C. H.

The eye of *Typhlomolge* from the artesian wells of San Marcos, Texas. 8: 251.

The eye of this salamander has lost its lens and most of the vitreous body and has collapsed as a result. The pupil is open in the young but becomes closed in the adult.

1898. Eigenmann, C. H. and Denny, W. A.

The eye of *Typhlotriton spelaeus.* 8: 252-253.

The eye of this salamander differs from the normal Amblystomid eye chiefly in the histological structure of the retina. The retina of the larva more nearly approaches the normal than does that of the adult, differing only in the thickness of the ganglionic layer. The larval retina possesses all the normal layers; the adult retina appears to lack the rods and cones and the outer molecular layer.

1900. Eigenmann, C. H.

A new species of cave salamander from the caves of the Ozarks in Missouri. (Abstract) 10: 167.

A new species (not named here) of *Spelerpes* is reported from several Missouri caves. It is a twilight species found within a short distance from the mouth of the cave.

1900. Slonaker, J. Rollin

Some observations on the daily habits of the toad (Bufo lentiginosus). 10: 167-170.

Terrarium observations on skin shedding, hibernation, feeding, and defensive behavior.

1901. Eigenmann, C. H.
The eye of *Rhineura floridana.* (Abstract) 11: 106.
Discussion of the anatomy of the eye of the Florida worm lizard and its possible phylogenetic and ontogenetic development.

1907. Bruner, Henry L.
The moulting mechanism in the heads of lizards. (Abstract) 17: 61.
The anatomical mechanism involved in moulting the skin of the head includes the veins and blood sinuses of the head, muscles distending the sinuses and raising the blood pressure, and the cardioaccellerator mechanism. These function to stretch and loosen the skin.

1907. Culbertson, Glenn
Some notes on the habits of the common box turtle, Cistudo carolina. 17: 78.
Describes an aggregation of 78 of these reptiles in a muddy pool and the subsequent destruction of many of them by hogs.

1909. Lane, H. H.
A paired entoplastron in *Trionyx* and its significance. (Abstract) 19: 345.
Anatomy and embryology of the entoplastron in *Trionyx.* The writer regards it as a very primitive character which occurs nowhere else among adult turtles living or fossil.

1910. Dennis, D. W.
A tropical reptile near Richmond, Indiana. 20: 137.
A large lizard killed near Richmond, Indiana, is identified as a specimen of *Iguana tuberculata.*

1914. Evermann, B. W. and Clark, H. W.
The snakes of the Lake Maxinkuckee region. 24: 337-348.
Descriptions and notes on the natural history of ten species of snakes collected near Lake Maxinkuckee in Marshall County, Indiana.

1916. Evermann, B. W. and Clark, H. W.
The turtles and batrachians of the Lake Maxinkuckee region. 26: 472-518.
The writers list nine species of turtles, eight species of salamanders, and ten species of frogs and toads from this Indiana locality and discuss the natural history of each form described.

1920. Sheak, W. Henry
Some observations on the pythons. 30: 115-118.
Notes on the feeding, skin shedding, and osteology of large snakes from observations on specimens exhibited in a wild animal show.

1924. Bigney, Andrew J.
Effect of adrenin on the pigment migration in the melanophores of the skin and in the pigment cells of the retina of the frog. (Abstract) 34: 141.

In melanophores of the skin, adrenin causes contraction; while in the retina the opposite effect is observed.

1925. Myers, George S.
A synopsis for the identification of the amphibians and reptiles of Indiana. 35: 277-294.
A key to the amphibians and reptiles of Indiana. Thirty-seven species of amphibians and sixty-three species of reptiles are listed; however the occurrence of some of these in Indiana is highly dubious.

1926. Myers, George S.
Notes on Indiana amphibians and reptiles. 36: 337-340.
Indiana records of sixteen species of amphibians and fourteen species of reptiles.

1927. Springer, Stewart
A list of amphibians and reptiles taken in Marion County, Indiana, 1924-1927. 37: 491-492.
Lists nineteen species of amphibians and nineteen species of reptiles from the vicinity of Indianapolis, Indiana.

1930. Grave, B. H.
The amphibians of Montgomery County, Indiana. 40: 339.
A list of seventeen species collected by the writer.

1930. Piatt, Jean
Herpetological report of Morgan County, Indiana. 40: 361-367.
Annotated list of nineteen species of amphibians and fourteen species of reptiles.

1934. Grant, Chapman
Notes on the spotted turtle in northern Indiana. 44: 224-247.
Discussion of secondary sexual differences in *Clemmys guttata*. Notes on changes in body proportion and color during growth.

1935. Lyons, M. W. and Bishop, C. A.
Bite of the prairie rattlesnake, *Sistrurus catenatus*. 45: 253-256.
Discussion of symptoms and treatment of cases reported from northern Indiana. Two case histories are presented. One, an adult, made an uneventful recovery. The other, a child four years old, developed a severe hemolytic anemia and died seven days after the injury.

1935. Grant, Chapman
Herpetological notes from northern Indiana. 45: 323-333.
Northwestern Indiana records for four species of salamanders, seven species of frogs and toads, four species of lizards, twelve species of snakes and nine species of turtles. Detailed field notes are included for each species.

1935. Reynolds, A. E. and Black, E. G.
The salamanders of Putnam County. 45: 287-294.
Records and descriptions of eight species from this Indiana county with ecological data.

1935. Grant, Chapman
Herpetological notes from Fort Knox, Kentucky. 45: 334.

An annotated list of specimens collected including two species of salamanders, two species of lizards, and two species of snakes.

1936. Allyn, William P.
Studies on poisonous snakes of Indiana. 46: 220-224.

Experimental studies on *Crotalus horridus, Sistrurus catenatus,* and *Agkistrodon mokasen.* These include comparison of the quantities of venom secreted; the effect of self-inflicted bites; the effect of bites inflicted upon other poisonous species; and the effect of venoms upon various non-poisonous species.

1936. Reynolds, A. E.
Additional observations on the salamanders of Putnam County and vicinity. 46: 225-229.

Discussion of the cave salamander, *Eurycea lucifuga,* as to description, measurements, and habits. The synonym of its specific name is reviewed. A table of the relative numbers of the forms of *Plethedon* collected in the area under consideration is given.

1936. Grant, Chapman
Orthogenic variation. 46: 240-245.

An analysis of the hypothesis proposed by Gadow that supernumerary scutes in young turtles represent an atavistic phenomenon. The writer suggests several alternative explanations of how the number of scutes may become reduced during maturation, namely: (1) The development of two aeroles into a single scute. (2) The failure of a small aerole to expand resulting in its subsequent obliteration by adjacent scutes. (3) The wandering or disappearance of sutures in aged turtles. In addition to these factors, the pressure of natural selection probably results in a higher mortality among the abnormal hatchlings.

1936. Grant, Chapman
The "midventral keel" in Testudinata. 46: 246-252.

The midventral keel or suture is a primitive character seen in many reptiles; however, the writer presents evidence to show it is improbable that the turtles possess such a structure. The midventral keel of *Dermochelys* is considered a modification of the umbilical scar; the intragular results from the fusion of two paired scutes; the interplastrals are remnants of paired scutes; and the so-called median scutes of the tail of *Chelydra* are actually pseudoscutes or fillers.

1938. Hamann, Cecil B.
A note on the occurrence of the spotted turtle, *Clemmys guttata,* in Indiana. 48: 227.

Report of a specimen taken near Logansport, Indiana.

1938. Allyn, W. P. and Shockley, C. H.
A preliminary survey of the surviving species of Caudata of Vigo County and vicinity. 48: 238-243.
The writers list twelve species of salamanders from the vicinity of Terre Haute, Indiana, with notes on habitat and natural history of each form. Their list is compared with that compiled by W. S. Blatchley in 1899.

1940. Torry, T. W. and Breneman, W. R.
Abnormalities in frog embryos induced by centrifugation. 50: 213-228.
The eggs of *Rana pipiens* were centrifuged at various speeds and at various stages of development. The early blastophore stage was most affected. Numerous embryos with accessory tails and underdeveloped or defective heads were obtained. The accessory tails possessed spinal cord, notochord, and muscle somites. Among other abnormalities produced were: (1) Total or partial absence of portions of the brain. (2) Absence of eyes, oral suckers, olfactory organs, stomatodeum, and hypophysis. (3) Variable duplications of the otocysts. (4) Suppression of the development of the prechordal mesoderm, pharynx, and visceral arches. (5) Reduction in the size of the heart and total absence in one case. (6) One instance of accessory pronephros associated with the presence of a secondary embryo.

1943. Stulkin, D. E., Randall, W. C. and Hiestand, W. A.
Respiration of the reptiles as influenced by the composition of the inspired air. (Abstract) 52: 188.
Description of the technique used in measuring respiratory movements in reptiles and in the collection of respired gases.

1944. Cooper, R. H.
A note on the occurrence of the massassauga rattlesnake, *Sistrurus catenatus,* in Delaware County. 53: 154.
Report of fifteen specimens of this snake from a swampy region near Muncie, Indiana.

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Comparative study of the cranial construction of these animals reveals features that show closer affinities to the Amphibia than to either the lizards or the snakes.

ANN ARBOR, MICHIGAN

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Size and Habits of the Cottonmouth Moccasin

By WILFRED T. NEILL

The cottonmouth moccasin, *Agkistrodon piscivorus piscivorus,* is one of the commonest snakes in the Coastal Plain of Georgia. Between 1934 and 1941 I collected over 400 specimens, most of which were kept alive for varying periods of time. Certain field notes and observations on captive examples may prove of general interest.

It has been assumed that the cottonmouth reaches a length close to 6 feet, but according to Schmidt and Davis (Field Book of Snakes of the United States and Canada, 1941: 286), the largest recorded example measured 58½ inches. A locality 11 miles west of Waynesboro, Burke County, Georgia, has yielded many specimens in excess of this length. Four female moccasins, taken here on the same day, measured 59, 62, 63, and 67 inches, respectively. The largest cottonmouth I have ever collected was also taken here on June 13, 1937. It was a female approximately 69 inches in length at the time of capture.

This snake refused all food until December, 1937, when the temperature in the reptile cages was lowered in order to simplify the winter feeding problem. It was then kept in a semi-dormant condition until March, 1938, at which time it drank about a pint of water and accepted a full-grown *Rana catesbeiana.* Each week thereafter it devoured several foot-long eastern pickerel. It would accept dead fish if they were placed in a pan of water. Bull-frogs were chased about the cage and swallowed as soon as caught. *Natrix sipedon fasciata* and *Masticophis flagellum flagellum* were treated in the same way. At the introduction of a large rat, the snake would coil with uplifted head and flickering tongue, apparently recognizing such prey as potentially dangerous. When the rat approached the moccasin, it would be met with a lunge that bowled the rodent across the cage. Several minutes thereafter, the snake would cautiously follow up its prey, evidently ready to strike again if the rat showed further signs of life (which none ever did). The rodent was always nudged and nosed about before being engulfed. Toads and large *Eumeces laticeps* were ignored. Other moccasins evoked no response from the large moccasin beyond a repeated upward jerking of the head—a motion that I have noted in various colubrid, boid, and crotalid serpents. In October, 1938, it sloughed its epidermis for the first time. A second ecdysis did not take place until May, 1939, although the snake had consumed great numbers of fish, frogs, snakes, sparrows, and rats. A third slough was cast in November, 1939, at which time the snake still measured about 69 inches in length. Growth had evidently very nearly ceased in this specimen.

The pugnacity of the cottonmouth is proverbial, but there seems to be no substantiated record of an unprovoked attack on man by this species. The following experience may thus be of interest. On August 8, 1946, a friend and I were collecting along the densely wooded bank of a small stream about 12 miles south of Augusta, Richmond County, Georgia. On

the opposite bank we spied a cottonmouth of perhaps a yard in length, basking on some cypress roots. The snake was separated from us by a steep 8-foot bank overgrown with *Smilax* and poison-ivy, and by a sluggish stream about 12 feet wide and 4 feet deep. Having already collected a good series from the area, we were preparing to leave the moccasin undisturbed, when it shook its tail angrily for a moment and then lunged open-mouthed in our direction. Its strike carried it into the stream, where it floated with uplifted head. Piqued by such belligerency, I seized a stick and scrambled down the bank into the stream. To my surprise, the cottonmouth swam to meet me. I waved the stick over its head; it did not strike at it until touched on the anterior part of the body. It embedded its fangs in the wood for a moment and then swam toward my legs. With the stick I pitched the snake onto the bank near the spot where it was first noted and, wading across, pinned it to the ground. Immediately the moccasin began a series of violent contortions, voiding the contents of the scent glands in every direction. Twisting out from under the stick, it dived into the cavities beneath the roots upon which it had originally been basking. The snake did not appear to be a gravid female. This is the only cottonmouth in my experience that made an entirely unprovoked attack when every opportunity for escape was presented.

The moccasin is more tolerant of cold than most snakes in this area, and is one of the last to go into hibernation. Specimens may be readily found in winter by tearing away the bark of rotting pine stumps on hillsides overlooking lakes or streams. Such snakes are quite active when disclosed, either making for the nearest water or attempting to burrow deeply into the soft wood. On cold days the moccasins cannot be found, evidently retreating far below the surface in the pulpy medium. On warm winter days (which are frequent in this area), they lie just below the bark, usually well above ground level. Occasionally they emerge completely to bask several feet away from the stump. I have never found more than one cottonmouth to a stump, although I once found two specimens hibernating together beneath a rotten log on a creek bank near Augusta, Richmond County, Georgia.

With the advent of cool weather, moccasins evidently make for higher ground, an action foreign to their behavior at other times. In most cases it is necessary for the serpent to climb to the top of the stump in order to reach an opening leading into the warm interior. The large number of cottonmouths found in stumps suggests that a well-defined behavior pattern is involved; that this pattern is innate is suggested by the frequent occurrence of young of the year in such surroundings. Winter search for *Agkistrodon p. piscivorus* usually reveals equal numbers of *A. mokeson austrinus, Elaphe obsoleta, E. guttata,* and *Lampropeltis getulus getulus,* all of which often resort to pine stumps for hibernation.

Recent experiments have suggested that an individual crotaline serpent may have a certain degree of immunity to its own venom, but may be affected by the poison of another example of its species (Swanson, 1946,

Copeia 4: 242). A cottonmouth pinned down with a stick often bites itself along with any other object in reach. I have seen this scores of times, but have never noted any ill effects on any specimen. I once dumped four freshly caught moccasins from a sack into a cage. An 18-inch example became excited and began striking at another individual about twice its size, hitting it three times. The larger snake dealt its attacker a severe bite at midbody. The smaller one died about eight hours later; the larger one was not noticeably affected.

I have several times noted that the famed ophiophage, *Lampropeltis getulus getulus,* is loath to attack a cottonmouth, under captive conditions. A tame, hungry king snake, placed in a cage with a moccasin two-thirds its length, usually becomes frightened, rooting about the cage in a desperate effort to escape. The cottonmouth remains motionless but alert, meeting the approach of its enemy with the peculiar "body blow" described for *Crotalus* (Cowles, 1938, Copeia 1: 13). This defense is very effective, the king snake redoubling its efforts to escape.

Extensive collecting has not revealed the presence of the water moccasin more than a few miles above the Fall Line, with one exception. There is a population of this species in the vicinity of Dry Fork Creek, the boundary between Wilkes and Oglethorpe Counties, Georgia, about 50 miles north of the Coastal Plain. The locality is unusual in several respects. Unlike the surrounding country, it is low and flat, the streams slow, silt-bottomed, and meandering. The aspect is so different from that of the typical Piedmont that the area is referred to as the "flatwoods" by many of the local residents. Here the cottonmouth has become firmly established, probably having reached the locality by way of the Savannah River and its tributary, the Broad.

AUGUSTA JUNIOR COLLEGE, AUGUSTA, GEORGIA

Desiderata: Mr. Sam R. Telford, Jr., wishes to trade Florida snakes for rodent-eating snakes of other areas.

Excerpts from *"Lacerta,"* herpetological monthly of the Netherlands, Vol. 5, Nos. 4, 5, 6, 7. Vier Heemskinderen Str. 159, The Hague Holland.

p. 29. J. B. ten Veen. Native salamanders; distribution, breeding.

p. 33. J. G. A. la Bastide. Snakes in the Priangan (West Java); discussion of *Natrix vittatus, Ptyas korros* etc.

p. 47. F. Pol. Muscular strength of *Coluber veridiflavus.*

p. 48. H. A. L. Menne. *Pipas* near Paramaribo.

p. 50. D. J. van der Laan. Discussion of *Hyla arborea* and *Emys orbicularis.*

p. 53. A. T. Reyst. *Xenopus mulleri;* description and discussion.

p. 56. N. R. Finsen. Experiments with salamander eggs; effect of blue and violet rays.

The Hemipenes of Copperhead Embryos

By DR. ALBERT M. REESE

In looking over a number of Copperhead *(Agkistrodon mokasen)* embryos of assorted sizes that had been deposited in the museum of zoology at West Virginia University, the writer was struck by the relatively enormous size of the hemipenes, especially in embryos at about the time of birth.

Unfortunately, the embryos were not promptly fixed after removal from the parent snakes, so that satisfactory sections could not be made.

Most books on snakes do not mention the hemipenes and even comparative anatomies usually describe them so briefly, generally giving no figures, that it was thought worth while to give a brief account of the organs in the Copperhead, in which animal, no description of the hemipenes has ever been published.

Kingsley (4) has a good figure of the hemipenes of *Crotalus* which resemble those of *Agkistrodon* fairly closely. He says: "Sphenodon lacks copulatory organs, but they occur in all other Sauropsida, one kind in Squamata only, the other kind (homologous to those in mammals) in crocodiles, turtles and some birds.

"The hemipenes develop from the posterior wall of the transverse anus, and in the embryonic stages they resemble appendages.

"They are present in both sexes, tho much smaller in the female.

"Each hemipenis, which may be notched or bifid at the tip, has a somewhat spiral groove for the passage of spermatazoa.

"These hemipenes are everted for copulation and are retracted at other times."

Bronn (2) gives good figures of the hemipenes in lizards but not in snakes.

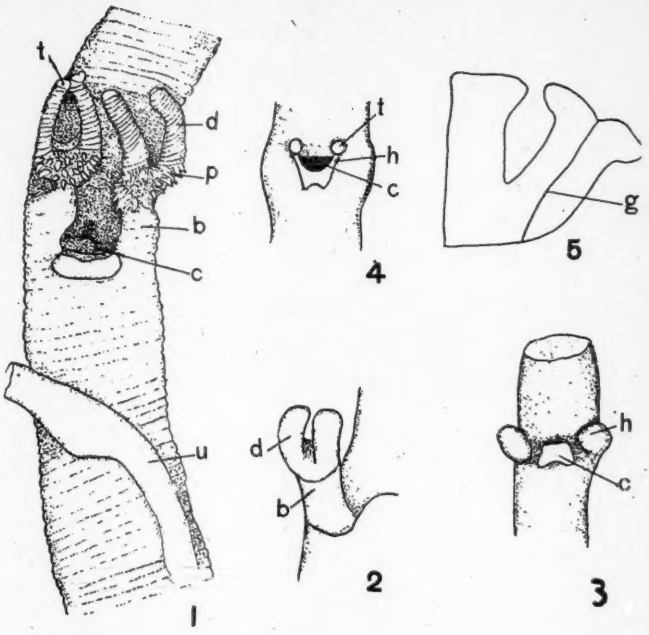
Beuchelt (1) gives a full account of these organs in two snakes, *Natrix natrix L* and *Vipera berus L;* an outline of one hemipenis of *Natrix* is shown in figure 5, traced from one of his drawings.

Unterhossel (5), more than forty years ago, gave a detailed account of the hemipenes and cloaca in lizards and snakes.

Clark (3), in a recent paper, gives a detailed description of the hemipenes in three common, non-venomous snakes, especially in relation to "Their value as criteria of relationship in the family Colubridae."

The first specimen to be described, by the present writer, is a new-born, or about-to-be-born, male of a total length of 17.5 cm.

It was the very conspicuous hemipenes of this animal that first attracted the writer's attention. Each hemipenis, Figure 1, is divided into two approximately equal branches, giving much the appearance of a crustacean claw. The distal two-thirds of the claw, d, except the tip, t, exhibits a series of distinct, scale like rings; while the proximal region, p, is covered with backwardly-pointing scales. The two branches of the organ unite to form a cylindrical, scaleless base, b, inserted at the outer edge of the



Description of Figures

Figure 1. A ventral view of a 17.5 cm. male Copperhead embryo, drawn from a camera lucida under very low power. b, basal region of hemipenis. c, cloaca. d, distal region of hemipenis. p, proximal region of hemipenis. u, umbilical cord.

Figure 2. A ventral view of the left hemipenis of a 6 cm. male Copperhead. b, basal region of hemipenis. d, distal region of hemipenis.

Figure 3. A ventral view of the cloacal region of a 3.5 cm. male Copperhead. c, cloaca. h, hemipenis.

Figure 4. A ventral view of the cloacal region of a 7.5 cm. female Copperhead. c, cloaca. h, hemipenis.

Figure 5. Dorsal view of hemipenis of male *Natrix natrix* L. g, dorsal sperm groove.

cloaca, c. How these two huge penes, each about 5 mm. in length, can be withdrawn into so small a cloaca it is difficult to understand. The sperm groove, described by other authors and shown in figure 5, can be made out, with difficulty, on the dorsal side of each branch of the hemipenis, the two grooves running together and disappearing in the basal section of the organ. Neither the spiral grooves nor the sperm duct could be made out in sections of the available material, due, as has been said, to the almost total lack of histological fixation.

Figure 2 is a ventral view of the left hemipenis of a Copperhead, 6 cm. long, drawn under higher magnification than was figure 1. The organ shows the two equal divisions, which are without visible scales; and no sperm grooves could be made out under low powers of the microscope.

Figure 3 shows the hemipenis in a 3.5 cm Copperhead, under approximately the same magnification as used with figure 2. As noted by others, the hemipenis, h, atthis early stage, resembles appendage buds; there is no indication of a division into two branches and there is but little distinction between basal and distal regions. The hemipenes seem quite distinct from the cloaca, c.

Figure 4 illustrates the difference between the female and male hemipenes. This embryo was 7.5 cm. in length, larger than the one represented in figure 2, where the hemipenes are quite well developed. Each organ, h, has a cylindrical body with a distinct, knob-like tip, t.

Figure 5 is an outline tracing of a dorsal view of one hemipenis of a male *Natrix natrix* L, taken from one of Beuchelt's (1) figures, presumably of an adult animal. It exhibits only a slight terminal bifurcation and no separation into basal and distal regions. No scales nor spine are shown. A distinct dorsal sperm groove, g, is shown. It is evidently a large organ in proportion to the size of the snake.

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WEST VA. UNIVERSITY, MORGANTOWN

American Caudata. I. Geographic Variation in *Manculus quadridigitatus*

By M. B. MITTLEMAN

With the exception of Cope's *Manculus remifer* (1871), which has variously been considered recognizable (Dunn, 1923, 1926) or indistinguishable (Bishop, 1941), no writer has questioned the homogeneity of *Manculus quadridigitatus* since the time of its original description by Holbrook (1842: 65). However, recent years have seen the gradual acquisition of many new specimens in collections, with the result that more and better material is now available for study, and a more definitive understanding of the geographic variation of this species is possible.

Despite a relatively wide distribution from the North Carolina Piedmont to the West Gulf Coastal Plain in Texas, and north to the Ozark Plateau in Missouri (Anderson, 1945), the structural characteristics of *quadridigitatus* are remarkably stable. Observable differences between various populations are largely quantitative, occasionally meristic, but never, so far as the observations made on 274 specimens are concerned, qualitative. It is perhaps due to this lack of obvious (qualitative) recognition characters that the majority of authors have considered *Manculus quadridigitatus* a monotypic form. Actually, the species is composed of three well-differentiated races, and in some directions it shows evidences of additional, more or less incipient raciation.

The present report is based upon data secured from a study of 246 specimens of *Manculus quadridigitatus,* representing all portions of the range of this species; in addition, 28 other specimens were examined, but their data were not recorded. For each specimen studied the following were recorded: locality, sex, costal groove count, costal grooves between appressed toes, vomerine teeth, head length (snout to gular fold, along the median ventral line), head width (posterior to the eyes), snout-vent length, and total length. Supplementary notes on color, pattern, secondary sexual characteristics, and the condition of the gonads, were made also on the majority of the specimens.

Color and pattern variations are fairly consistent throughout the range of *quadridigitatus,* i.e., various phases are found with approximately equal frequency in all parts of the range. Hence, I am unable to distinguish specimens from one locality or another on the basis of color and/or pattern with any degree of consistency. In a like measure, mensural and proportional differences are but poorly correlated with geographic distribution, and therefore do not serve as a useful basis for differentiating the vicarious populations involved. On the other hand, vomerine and costal groove counts, and the number of costal grooves between the appressed toes, have been found to correlate with geographic distribution to a significant degree, and therefore provide a useful means of recognizing three annectant populations. The geographic variations inherent in *Manculus quadridigitatus,* as discussed in the present paper, are based largely on a study of these three characters.

VOMERINE COUNTS

A count of the teeth in the left and right vomerines was made on each specimen. Because considerable variation exists in the number of teeth per series (a specimen may have five teeth in the left series and seven in the right, for example), it was found that a more satisfactory means of analysing the quantitative variation in the vomerine count was obtained by using the total count for each specimen, i.e., the combined count of the left and right series. Therefore in the discussion which follows, all vomerine counts are "combined counts," unless stated to the contrary.

Sexual Dimorphism

Analysis shows that for practical purposes of populational comparisons, no significant sexual dimorphism exists in the number of vomerine teeth. For example, in a series of 45 specimens collected at Gayle, Caddo Parish, La., 25 males have combined vomerine counts ranging from 8 to 16, while 20 females have counts between 10 and 20, as follows:

Combined Vomerines

	8	9	10	11	12	13	14	15	16	17	18	19	20	N
♂	1		8	1	4		5	1	5					25
♀			2	1	4	3	4	1	3				2	20

Table 1. Sexual variation in combined vomerine counts in 45 specimens of *Manculus quadridigitatus* from Gayle, Caddo Parish, La.

In this sample, 14 out of 25 males have counts of 12 or less, while 13 females have counts of 13 or more; hence, only 27 specimens out of a total of 45 (=60%) are separable as to sex on the basis of the combined vomerine count. Despite some slight tendency toward a higher count in females, the observed difference is almost certainly due to a sampling error (chi-square=1.9), and studies made on much larger series confirm this observation. Therefore, in making populational comparisons, the counts of males and females have been pooled.

Ontogenetic Variation

In certain caudate genera and families, an ontogenetic variation in the number of vomerine teeth is detectable. In the case of *Manculus quadridigitatus* a slight trend in this direction is observable, but is of no statistical significance. Using the Gayle sample again, it is found that these 45 specimens vary from 26 to 36 mm. in snout-vent length, with combined vomerine counts ranging from 8 to 20. The following variations in combined vomerine counts, according to snout-vent length, may be observed:

Snout-vent length	Range of combined vomerine counts	N
26 mm.	13	1
27	10	1
28	14-20	2
29	10-16	5
30	11-16	7
31	10-16	10
32	10-16	7
33	8-20	9
34	—	0
35	12-14	2
36	16	1
		45

Table 2. Variation in combined vomerine counts by snout-vent size in 45 specimens of *Manculus quadridigitatus* from Gayle, Caddo Parish, La.

If these specimens are segregated into two groups, one consisting of specimens from 26 to 31 mm., and the other comprised of individuals from 32 to 36 mm., it may be seen that some small degree of association exists between the combined vomerine count and the snout-vent length, thus:

Snout-vent length	Range of combined vomerine counts		N
	8 - 13	14 - 20	
26 - 31	15	11	26
32 - 36	9	10	19

Table 3. Variation in combined vomerine counts in two size groups of *Manculus quadridigitatus* from Gayle, Caddo Paris, La.

So far as this single sample goes, there is a minor trend toward a greater number of vomerine teeth in larger specimens. However, the difference is quite insignificant, and results from random sampling errors (chi-square=.50). Thus, in making populational comparisons, vomerine counts for specimens of all sizes have been used.

Geographic Variation

Holbrook *(loc. cit.)* stipulated no more exact type locality for his *Salamandra quadridigitata* than the fact that his specimens came from South Carolina, Georgia, and Florida. A tabulation of the combined vomerine counts of 59 speciments of both sexes from these three states reveals the following variations:

Combined Vomerines														
7	8	9	10	11	12	13	14	15	16	17	18	19	20	N
1	3	2	14	6	10	7	4	3	4	1	1	2	1	59

Table 4. Variation in combined vomerine counts in 59 specimens of *Manculus quadridigitatus* (both sexes) from South Carolina, Georgia, and Florida.

By comparison, the combined vomerine counts in 31 specimens of both sexes from North Carolina, Alabama, and Mississippi display a somewhat different pattern of variation:

Combined Vomerines								
7	8	9	10	11	12	13	14	N
2	2	3	8	4	7	4	1	31

Table 5. Variation in combined vomerine counts in 31 specimens of *Manculus quadridigitatus* (both sexes) from North Carolina, Alabama, and Mississippi.

There is some degree of difference between the counts of the South Carolina-Georgia-Florida series on the one hand, and the North Carolina-Alabama-Mississippi series on the other, since 12 specimens out of 59 in the first sample have counts ranging from 15 to 20, as compared to a maximum count of 14 in the latter sample. The differences are not statistically significant, and further study shows that the observed disparity results largely from the inclusion of the counts of certain specimens from peninsular Florida and southeastern Georgia in the first sample. This is well shown when the counts of the North Carolina-Alabama-Mississippi series are compared with those of specimens from South Carolina, Georgia (except eastern Brantley County), and non-peninsular Florida (Leon, Liberty, and Jackson counties), as follows:

	Combined Vomerines														
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	N
South Carolina, Georgia (except eastern Brantley Co.), west Fla.		1	1	10	4	6	3	1	1	1				1	29
North Carolina, Alabama, Mississippi	2	2	3	8	4	7	4	1							31

Table 6. Comparison of combined vomerine counts in samples of *Manculus quadridigitatus* from South Carolina-Georgia-Florida, and North Carolina-Alabama-Mississippi.

If the counts of the North Carolina-Alabama-Misissippi series are pooled with those from South Carolina, Georgia (except eastern Brantley County), and non-peninsular Florida (Leon, Liberty, and Jackson counties), and are then compared with those of 30 specimens from eastern Brantley County, Ga., and Alachua, Pinellas, Lake, Orange, Seminole, and

Indian River counties, Florida, it is found that there is a perceptible trend in the latter sample toward a greater number of vomerine teeth, as may be seen in the following tabulation:

	Combined Vomerines															
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	N
North Carolina, South Carolina, Georgia (except east Brantley Co.), west Florida, Alabama, Mississippi	2	3	4	18	8	13	7	2	1	1				1	60
Peninsular Florida, eastern Brantley Co., Ga.	1	2	1	4	2	4	4	3	2	3	1	1	2		30

Table 7. Comparison of combined vomerine counts in *Manculus quadridigitatus* from southeastern Georgia and peninsular Florida, with specimens from other parts of Georgia, the Carolinas, non-peninsular Florida, Alabama, and Mississippi.

Dunn (1926: 336) has suggested the applicability of the name *remifer* for the dark-pigmented population with long vomerine series occupying a narrow coastal strip in Florida east of the St. Johns River. More recently Bailey (1937: 9) has used this name for five specimens from a locality one mile east of Waynesville, Brantley County, Georgia, which agree with Dunn's diagnosis of *remifer,* in that they are dark and have long vomerine series (there are three females and two males in this series, with the following combined vomerine counts: 8, 16, 19, 10, 16). The validity of the race *remifer* appears superficially to be corroborated by the comparison of vomerine counts made in Table 7. However, *remifer,* if valid, cannot be restricted to the area lying east of the St. Johns River (and southeastern Georgia), for as Carr (1940: 48) has pointed out, the longer vomerine series and darker color of the east-Florida specimens are found commonly in individuals from other parts of Florida. For example, in 25 specimens from Alachua, Pinellas, Lake, Orange, Seminole, and Indian River counties showing a total vomerine range of 7 to 19, counts of 13 or more are found in 14 specimens. Conversely, 12 specimens from Leon, Liberty, and Jackson counties have counts ranging from 10 to 20, with eight specimens having a count of 12 or less. Judging from these dispersions, on the basis of which 22 specimens out of 37 (=59.5%) can be geographically identified, it seems likely that Carr is correct (*loc. cit.*) in believing that "*remifer* is in the process of being absorbed by (or of absorbing) *quadridigitata* rather than being differentiated through isolation with the St. Johns as a barrier." No real dichotomous difference in vomerine counts exists between the populations inhabiting the various parts of Florida. If the combined vomerine counts of all Florida specimens and those from eastern Brantley County, Georgia, are pooled and then compared with the counts of specimens from elsewhere in Georgia, the Carolinas, Alabama, and Mississippi, the following frequency distributions are obtained:

	Combined Vomerines														
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	N
North Carolina, South Carolina, Georgia (except east Brantley Co.), Alabama, Mississippi	2	3	4	16	5	10	6	2							48
Florida, east Brantley Co.,Ga.	1	2	1	6	5	7	5	3	3	4	1	1	2	1	42

Table 8. Comparison of combined vomerine counts in 42 specimens of *Manculus quadridigitatus* from Florida and southeastern Georgia, with those of 48 specimens from other parts of Georgia, the Carolinas, Alabama, and Mississippi.

So far as the dispersions in Table 2 are concerned, a certain degree of segregation is detectable between the specimens from Florida and southeastern Georgia on the one hand, and the remainder of Georgia, the Carolinas, Alabama, and Mississippi on the other. If a count of 12 is considered the critical point, then 27 specimens out of 42 from Florida and southeastern Georgia, and 30 specimens out of 48 from Georgia, the Carolinas, Alabama, and Mississippi, or a total of 57 speciments out of 90 (=63%) are separable as to geographic origin on the basis of the combined vomerine counts. Yet I do not believe that the nomenclatorial recognition of an east Florida-plus-southeastern Georgia, or a Florida-plus-southeastern Georgia race is warranted. The observed differences in dentition represent a clinal gradient rather than a nodal one, and the populational changes which take place in the number of teeth occur by almost imperceptible degrees, geographically speaking. Moreover, I have not been able to ascertain any other structural differences, and color is certainly not reliable.

The general pattern of vomerine counts exhibited by the populations occupying the Piedmont and southeastern Coastal Plain changes rather abruptly along the Pearl and Mississippi rivers between Louisiana and Mississippi. Thus, 13 Missisippi specimens from Harrison, Hancock, Pearl River, Lawrence, and Wilkinson counties (eight males, five females), have combined vomerine counts ranging from 7 to 13, of which 10 specimens (=77%) have counts of 12 or less. By comparison, in 15 specimens from Washington, St. Tammany, and St. Helena Parishes, Louisiana (seven males, eight females), the combined vomerine counts vary from 10 to 19, of which ten specimens (=66.6%) have counts of 13 or more. The significant difference betwen these two small samples is sustained when larger series of specimens are examined, so that specimens from Louisiana, Texas, and Missouri are, as a group, palpably different from those occupying the area east of the Mississippi River. A tabulation of 246 combined vomerine counts shows this geographic association:

	Combined Vomerines																
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	N
E. of Miss. River	3	5	5	22	10	17	11	5	3	4	1	1	2	1			90
W. of Miss. River		1	2	21	5	22	9	32	13	29	5	7	2	7		1	156

Table 9. Comparison of combined vomerine counts in samples of *Manculus quadridigitatus* from localities east and west of the Mississippi River.

With 62 specimens out of 90 from localities east of the Mississippi River having counts of 12 or less, and 105 specimens out of 156 from areas lying to the west of the River having counts of 13 or more, 167 specimens out of a total of 246 (=68%) are distinguishable as to their general geographic provenance on the basis of vomerine counts alone. Analysis of these dispersions by chi-square results in a value of 11.5, indicating that there is a highly significant association between geographic distribution and vomerine counts in these specimens, with the chances of the observed differences resulting from random errors in sampling being much less than 1 in 100.

West of the Mississippi River the trend toward a higher vomerine count is most noticeable in an east-west direction, with specimens from southern and central Louisiana and adjacent Texas exhibiting somewhat longer vomerine series than those from extreme northwestern Louisiana (Caddo and DeSoto Parishes) and Missouri. In a pooled sample of 104 specimens from Louisiana (except Caddo and DeSoto Parishes) and eastern Texas, the combined vomerine counts range from 9 to 22, with 76 out of 104 specimens having counts of 13 or more, and 70 specimens out of the 104 having counts of 14 or more. In a series of 52 specimens from Caddo and DeSoto Parishes, Louisiana, and Barry County, Missouri, the spread is from 8 to 20, with 29 specimens having counts of 13 or more, and 26 specimens having counts of 14 or more. The variations in these two samples may be seen in the following tabulation:

	Combined Vomerines															
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	N
Texas, Louisiana (less Caddo and DeSoto Par.)		2	10	3	13	6	21	10	19	5	7	2	5		1	104
Caddo and DeSoto Parishes, La., Barry Co., Mo.	1		11	2	9	3	11	3	10				2			52

Table 10. Comparison of combined vomerine counts in two samples of *Manculus quadridigitatus* from localities west of Mississippi River.

Comparison of the counts of specimens from southern (and central) Louisiana, and Texas, with those of specimens from stations east of the Mississippi River shows a highly significant difference (chi-square=25). A similar comparison between the counts of the specimens from Caddo and DeSoto Parishes, and Barry County, with those of the eastern specimens likewise shows a statistically significant association between geographic provenance and vomerine counts, but to a lesser degree (chi-square=8.3). The observed differences between the southern Louisiana and Texas specimens on the one hand, and those from northwestern Louisiana and Missouri on the other, are almost certainly due to random sampling errors, and cannot be held significant (chi-square=4.3). The relationship between these two series of specimens is a good deal similar to that which exists between the Floridian and southeastern Georgia specimens as compared to the other populations ranging from North Carolina to the Mississippi River (see Table 8).

COSTAL GROOVES

The maximum-count method has been used in taking costal groove counts, whereby all costal grooves lying between the axilla and groin are included. Grooves lying immediately above the fore- or hindlimbs have not been counted unless they extend ventrad below the upper level of the insertion of the limb within the axilla or groin. Neither sexual dimorphism nor ontogenetic variation is detectable in the costal groove counts, so that all samples represent pooled data based on males and females of all sizes.

Geographic Variation

A geographic gradient in the number of costal grooves is discernable from the northeast part of the range of *quadridigitatus* to the southwestern part, and from the southwestern part to the northwestern limit. Specimens from North Carolina to the Mississippi River have from 14 to 17 costal grooves, with 47 specimens out of 90 (=52%) having counts of 16 or 17. Specimens from Louisiana (except the northwestern part) and Texas similarly vary from 14 to 17 in their costal groove counts, but 77 out of 104 individuals (=74%) have counts of 16 or 17. Finally, in 52 specimens from Caddo and DeSoto Parishes, Louisiana, and Barry County, Missouri, 100% have a count of either 16 or 17, with 34 specimens (=65%) having a count of 17. The variations in these three samples may be seen in the following tabulation:

	Costal Grooves				
	14	15	16	17	N
North Carolina to Mississippi	4	39	43	4	90
Texas, Louisiana (less northwestern part)	1	26	68	9	104
Caddo and DeSoto Parishes, La., Barry Co., Mo.			18	34	52

Table 11. Geographic variation in costal groove counts in *Manculus quadridigitatus*.

The transition in costal groove counts in northwestern Louisiana specimens is abrupt. In a sample of 21 specimens from Bienville, Grant, Natchitoches, Jackson, and Ouachita Parishes, the range of costal counts is 15 - 17, with 19 specimens (=90%) having 15 to 16 grooves. By comparison, in 50 specimens from Caddo and DeSoto Parishes, 33 specimens (=66%) have 17 costal grooves. On the basis of costal groove counts, 73% of these northwestern Louisiana specimens can be correctly separated as to their geographic origin. The differences between the dispersions of costal groove counts in northwestern Louisiana material results in a chi-square value of 18.8, and is highly significant of a valid association between geographic distribution and the costal groove count.

While it is apparent that only about two-thirds of the specimens from Caddo and DeSoto Parishes, and Barry County, are distinguishable from other specimens on the basis of the costal groove count, it should be pointed out that in the 194 specimens in the other two samples, only 13 (6.7%) have similarly high counts. Hence, if the specimens from Caddo and DeSoto Parishes, and Missouri with 17 grooves are to be compared with material from elsewhere in the range of *quadridigitatus,* these 34 specimens, together with 181 individuals bearing 16 grooves or less from other localities, or slightly more than 87% of the total, are identifiable as to geographic origin on the basis of costal groove counts alone.

COSTAL GROOVES BETWEEN APPRESSED TOES

It is well known that the number of costal grooves between the appressed toes in salamanders is subject to ontogenetic variation. Sexual maturity in *Manculus quadridigitatus* appears to be attained in male specimens of 23 mm. snout-vent length, and in females of 24.5 mm., judging from secondary sexual characteristics and the condition of the gonads. Below these limits sexual immaturity is linked with relatively long limbs, so that in specimens which are sexually immature, the number of costal grooves between the toes is invariably one or two. With the attainment of sexual maturity there is a concomitant increase in the relative length of the trunk, i.e., the heterogonic relationship between the trunk and limbs is such that the limbs appear much shorter proportionately. Correspondingly therefore, sexually mature *Manculus* have a greater number of costal grooves between the appressed toes. However, there is considerable latitude between snout-vent length and the number of grooves between the toes, and specimens of 32 mm. may have only 2 or 3 grooves between the toes, while some specimens as small as 26 or 27 mm. may have as many as 4 grooves between the toes. Therefore, in making populational comparisons, the only criterion for utilization of the count made on a particular specimen is whether the specimen is sexually mature or not. Except in the case of ripe females distended with eggs, no sexual dimorphism is apparent in the number of grooves between the toes; all such gravid specimens have been excluded from the comparisons which follow.

Geographic Variation

As in the case of the vomerine and costal groove counts, there is a noticeable geographic gradient in the number of costal grooves between the appressed toes. Thus, out of 84 sexually mature specimens from localities east of the Mississippi River showing a total range of 1 to 5 grooves between the toes, 73 specimens (=87%) have counts from 3 to 5. In 51 specimens from Caddo and DeSoto Parishes, Louisiana, and Barry County, Missouri, the range is from 2 to 6, with 50 specimens out of 51 (=98%) showing a count from 3 to 6. In 99 specimens from other localities in Louisiana, and Texas, the variation is from 3 to 6 grooves, with 100% of the specimens falling within this range. The frequency distributions for these samples may be seen in the following tabulation:

Costal Grooves Between Appressed Toes

	1	2	3	4	5	6	N
North Carolina to Mississippi	1	10	28	37	8		84
Caddo and DeSoto Parishes, La., Barry Co., Mo.		1	13	29	7	1	51
Louisiana (less northwestern parishes), Texas			26	47	22	4	99

Table 12. Geographic variation in the number of costal grooves between the appressed toes in sexually mature *Manculus quadridigitatus*.

Further analysis shows that out of 28 specimens from Texas, 13 (=46%) have 5 or 6 grooves between the toes. In 71 specimens from various Louisiana stations (except Caddo and DeSoto Parishes), 13 (=18.3%) have as high a count as 5, while in 51 specimens from Caddo and DeSoto Parishes, and Barry County, Missouri, a count of 5 occurs 7 times and a count of 6 occurs once, thus accounting for 15.7% of the total number. In 84 specimens from localities east of the Mississippi River, a count of 5 occurs 8 times (=9.5%), as compared to 34 counts out of 150 (=22.6%) as high as 5 or 6 in trans-Mississippi specimens.

Whein viewed collectively, these analyses indicate that the species *quadridigitatus* as currently defined is a composite form comprised of three annectant races. The component forms are *M. q. quadridigitatus* extending from North Carolina south to central Florida and west through Mississippi; a race, *M. q. paludicolus,* n. ssp., distributed from Washington and St. Tammany Parishes, Louisiana, north to Ouachita, Jackson, Bienville, and Natchitoches Parishes, and extending southwest to Leon and Austin Counties, Texas; and a third race, *M. q. uvidus,* n. ssp., found in Caddo and DeSoto Parishes, Louisiana, and Barry County, Missouri, and presumably also in Crawford and Lafayette counties, Arkansas (Smith, 1933: 321) and Oklahoma (Bishop, 1943: 446). The definitions of these three races follow.

Manculus quadridigitatus quadridigitatus (Holbrook)

1842 *Salamandra quadridigitata* Holbrook, N. Amer. Herp., ed. 2, 5: 65, pl. 21, type locality South Carolina, Georgia, and Florida.

1869 *Manculus quadridigitatus* Cope, Proc. Acad. Nat. Sci. Phila., p. 101; 1889, Bull. U. S. Nat. Mus., 34: 159 (*part.*); Bishop, 1943, Handbook Salam., p. 446 (*part.*).

1923 *Manculus quadridigitatus quadridigitatus* Stejneger and Barbour, Check List N. Amer. Amph. Rept., ed 2: 14 (*part.*); *ibid.*, 1933, ed. 3: 16 (*part.*); *ibid.*, ed. 4: 26 (*part.*).

1923 *Eurycea quadridigitata quadridigitata* Dunn, Proc. N. Eng. Zool. Club, 8: 40 (*part.*); 1926, Salam. Fam. Pleth., p. 331 (*part.*); Carr, 1940, Univ. Fla. Biol. Sci. Ser., 3, 1: 48.

1871 *Manculus remifer* Cope, Rept. Peabody Acad., p. 84; type locality Jacksonville, Florida; 1889, Bull. U. S. Nat. Mus., 34: 158.

1923 *Manculus quadridigitatus remifer* Stejneger and Barbour, Check List N. Amer. Amp. Rept., ed. 2: 14; *ibid.*, 1933, ed. 3: 16; *ibid.*, 1939, ed. 4: 26.

1923 *Eurycea quadridigitata remifera* Dunn, Proc. N. Eng. Zool. Club, 8:40; 1926 Salam. Fam. Pleth., p. 336; Bailey, 1937, Occ. Pap, Univ. Mich., Mus. Zool., 364: 9; Carr, 1940, Univ. Fla. Biol. Sci. Ser., 3, 1: 48.

Diagnosis: Combined vomerines 7 - 20 (3 - 11 teeth per series), 7 - 12 in 70% of specimens; costal grooves 14-17, 14-16 in 95% of specimens, 14-15 in 47% of specimens; costal grooves between appressed toes 1-5, 1-4 in 90% of specimens (1-3 in 46% of specimens, 4-5 in 54% of specimens); maximum total length 86 mm. (male, UMMZ[1] 77151, near Gainesville, Alachua County, Fla.).

Range: Raleigh, North Carolina, and Abbeville, South Carolina, south through the Coastal Plain to Indian River and Pinellas counties, Florida; north to Bibb County, Georgia; west through Alabama to Hancock, Pearl River, and Wilkinson counties, Mississippi.

Specimens studied 90, as follows:

NORTH CAROLINA—*Wake County:* Raleigh (UMMZ, 52415, 65904; BU 566, 568-72, 689; USNM 57395-6). *Columbus County:* Lake Waccamaw (USNM 91735-6).

SOUTH CAROLINA—*locality uncertain:* Wassamassaw Swamp (USNM 73547-8).

GEORGIA—*Bibb County:* no definite locality (USNM 39510-11). *Brantley County:* 1 mi. W. of Hoboken (USNM 92317); 1 mi. E. of

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[1] Abbreviations for collections are: UMMZ=University of Michigan Museum of Zoology; USNM=United States National Museum; CAS=Chicago Academy of Sciences; BU=Baylor University; PV=private collection of Percy Viosca, Jr.; BCB=private collection of Bryce C. Brown; FP=private collection of Floyd E. Potter, Jr.; TCWC=Texas Cooperative Wildlife Collection (Texas A. & M. College); MBM=private collection of M. B. Mittleman; HMS=private collection of Hobart M. Smith.

Waynesville (UMMZ 67799, 5 spec.). *Dooly County*: 4 mi. S. of Vienna (USNM 92276-81). *Glynn County:* 5 mi. W. of Brunswick (USNM 92161); Belle Vista (CAS 12793-4. *Grady County:* no definite locality (UMMZ 86458). *Liberty County:* Riceboro (USNM 3804, 3 spec.).

FLORIDA—*Alachua County:* San Falasky (UMMZ 77154, 2 spec.); near Gainesville (UMMZ 77152, 2 spec.; 77153, 3 spec.; 77151, 2 spec.); 3 mi. W. of Gainesville (UMMZ 57833, 3 spec.); Gainesville (UMMZ 61748, 4 spec.); no definite locality (UMMZ 56545. *Jackson County*: Marianna (UMMZ 68854). *Lake County*: near Esmeralda USNM 69854-6). *Leon County*: no definite locality (UMMZ 56704, 5 spec.). *Liberty County*: near Rock Bluff (UMMZ 75982, 5 spec.); no definite locality (UMMZ 86542). *Seminole County*: Oviedo (USNM 21328).

ALABAMA—*Lee County;* near Auburn (UMMZ 83225). *Mobile County*: Mobile (USNM 42554-5; BU 564-5).

MISSISSIPPI—*Hancock County:* no definite locality (UMMZ 95020). *Harrison County*: Biloxi (USNM 51156; UMMZ 89495; UMMZ 77038, 5 spec.); near Ramsey (UMMZ 76223, 2 spec.). *Lawrence County:* 4 mi. W. of Monticello (USNM 99306). *Pearl River County:* Boley Swamp, near Picayune (PV, 1 spec.). *Wilkinson County:* Woodville (UMMZ 76330, 2 spec.). *Locality uncertain:* Cedar Lake (UMMZ 77039).

Additional specimens examined:

FLORIDA—*Leon County:* no definite locality (UMMZ 56704, 22 spec.).

Manculus quadridigitatus paludicolus, n. ssp.

Diagnosis: Combined vomerines 9-22 (4-11 teeth per series), 13-22 in 73% of specimens; costal grooves 14-17, 14-16 in 91% of specimens, 16-17 in 74% of specimens; costal grooves between appressed toes 3-6 (100% of specimens), 4-6 in 74% of specimens, 5-6 in 26% of specimens; maximum length 90 mm. (male, holotype).

Range: Washington and St. Tammany Parishes, north to Ouachita, Jackson, Bienville, and Natchitoches Parishes, Louisiana; west to Leon and Austin counties, Texas.

Holotype: An adult male (one of a series of nine specimens) in the collection of Percy Viosca, Jr., collected by Mr. Viosca at Pollock, Grant Parish, Louisiana, September 6-9, 1937; to be deposited in the U. S. National Museum.

Paratypes: See list of specimens studied.

Specimens studied 103 as follows:

LOUISIANA—*Bienville Parish:* Bienville (UMMZ 75940, 5 spec.). *East Baton Rouge Parish:* Indian Mound (PV, 1 spec.). *Evangeline Parish*: no defiinite locality (UMMZ 75941, 8 spec.). *Grant Parish*: Pollock (PV, 8 spec.). *Jackson Parish*: 5 mi. W. of Jonesboro (PV, 1 spec.). *Jefferson Parish*: Harahan (PV, 2 spec.); Bohon (PV, 6 spec.); 8 mi. S. of Marrero (PV, 5 spec.). *La Salle Parish*: Fishville (PV, 5 spec.). *Natchitoches Parish*: Kisatchie (PV, 4 spec.). *Ouachita Parish*:

Monroe (PV, 2 spec.). *Rapides Parish*: 10 mi. W. of Alexandria (PV, 9 spec.); Forest Hill (PV, 1 spec.). *Sabine Parish*: 4 mi. SW. of Many (USNM 99176-7); 2 mi. NW. of Many (CAS 11292). *St. Helena Parish*: Greensburg (PV, 1 spec.). *St. Tammay Parish*: Mandeville (PV, 1 spec.); Covington (PV, 10 spec.); Pearl River (PV, 2 spec.). *Washington Parish*: Sheridan (PV, 1 spec.).

TEXAS—*Anderson County*: Palestine (USNM 17700). *Austin County*: 6 mi. E. of Kenney (BCB 485; BCB 753-6); 2 mi. E. of Industry (FP 28; FP 30). *Leon County*: Normangee State Park, near Normangee (BCB 1327-8; BCB 1568-71; MBM, 2 spec.; TCWC 1198-1204). *Sabine County*: 5 mi. SW of Pendleton Ferry (USNM 99773-6). *Tyler County*: Hillister (USNM 99762).

Additional specimens examined:

LOUISIANA—*locality uncertain*: Camp Claiborne (UMMZ 93135, 5 spec.).

TEXAS—*Jasper County*: along Neches River bottom, Cypress Point (HMS, 1 spec.).

Manculus quadridigitatus uvidus, n. ssp.

1926. *Manculus quadridigitatus quadridigitatus* Strecker and Frierson, Contrib. Baylor Univ. Mus., 5: 3.

1945. *Manculus quadridigitatus* Anderson, Bull. Chi. Acad. Sci:, 7, 5: 271.

Diagnosis: Combined vomerines 8-20 (4-10 teeth per series), 13-20 in 56% of specimens; costal grooves 16-17 (100% of specimens), 17 in 65% of specimens; costal grooves between appressed toes 2-6 (100% of specimens), 4-6 in 72% of specimens, 5-6 in 15.7% of specimens; maximum length 87 mm. (female, BU 0007, Mansfield, DeSoto Parish, Louisiana).

Range: Caddo and DeSoto Parishes, Louisiana, north to Barry County, Missouri. Probably also Crawford and Lafayette counties, Arkansas *(vide* Smith, *loc. cit.)*, and eastern Oklahoma *(vide* Bishop, *loc. cit.)*.

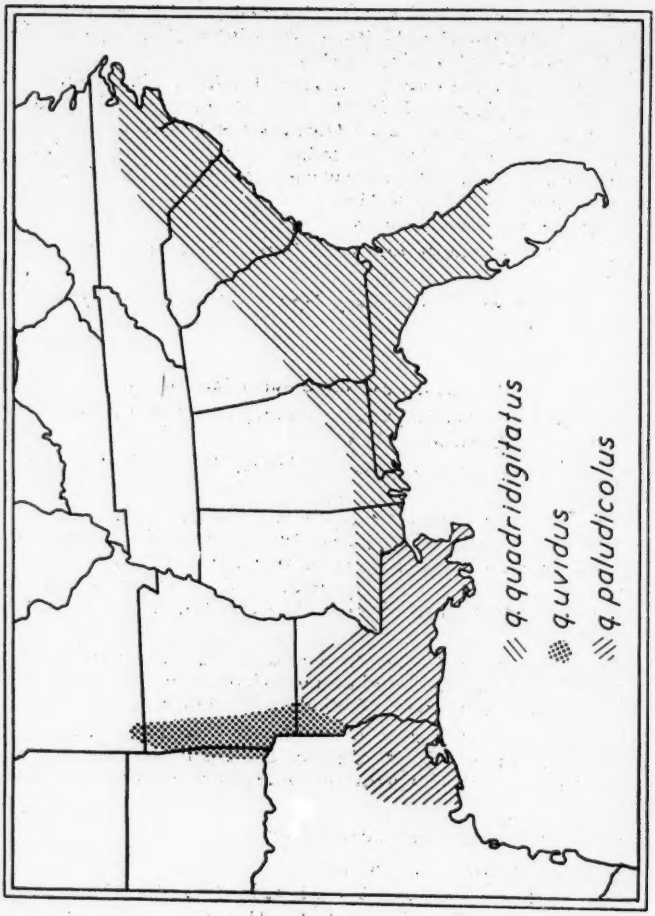
Holotype: An adult male in the Baylor University collection (BU 2338), collected by John K. Strecker and Lorraine S. Frierson, Jr., at Gayle, Caddo Parish, Louisiana; to be deposited in the U. S. National Museum.

Paratypes: See list of specimens studied.

Specimens studied 51, as follows:

LOUISIANA—*Caddo Parish:* Gayle (BU 573-6, BU 1359, BU 1361-2, BU 2263-9, BU 2271-3, BU 2276, BU 2333-41, BU 4151, BU 4153-4, BU 4156-7, BU 4162-3, BU 4168-73, BU 4176-8, BU 4270). *DeSoto Parish:* Mansfiield (BU 0007-0010, BU 0012).

MISSOURI—*Barry County*: Roaring River State Park (CAS 12900; PA 4521).



Distribution of the races of *Manculus quadridigitatus*

The following key will correctly separate 80% of the sexually mature specimens examined.

Key to the Races of *Manculus quadridigitatus*

1. Combined vomerine count 12 or less..... 2
   Combined vomerine count 13 or more..... 3

2. Costal grooves 16 or less. Raleigh, N. C., south to middle Florida, and west through Mississippi.
   M. q. quadridigitatus
   Costal grooves 17. Caddo and DeSoto Parishes, Pa., to Barry Co., Mo., probably eastern Oklahoma and Crawford and Lafayette counties, Arkansas.
   M. q. uvidus

3. Costal grooves 16 or less..... 4
   Costal grooves 17. Caddo and DeSoto Parishes, Pa., to Barry Co., Mo., probably eastern Oklahoma and Crawford and Lafayette counties, Arkansas.
   M. q. uvidus

4. Costal grooves between appressed toe 1-5, usually 3 or 4 (77%). Raleigh, N. C., south to middle Florida and west through Mississippi.
   M. q. quadridigitatus
   Costal grooves between appressed toes 3-6, usually 4-6 (79%). Louisiana (except Caddo and DeSoto Parishes) west to Leon and Austin counties, Texas.
   M. q. paludicolus

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470 PELHAM ROAD, NEW ROCHELLE, NEW YORK.

Prevalence of Snakes in Haiti

By ANTHONY CURTISS

Some authors have stated that snakes are practically unknown or very rare in Haiti. The late Dr. Barbour states that *Uromacer catesbyi* is widespread, but rather rare. It is really very common, even in the gardens of this town, as many specimens sent to Dr. Cochran attest. Dr. Barbour stated that *Epicrates striatus* seems to be really uncommon. Every large dead tree which we have opened in the low lands, even in local gardens, contained one or more of these snakes. Many unopened trees are from time to time festooned with their shed skins. We find large boas stretched on branches after rainy nights or in our houses pursuing rats. I have found no boas in the mountains.

In some places the boa is respected as being the emblem of one of the jinn; hence Dr. Barbour may not have seen it. He used to send out blacks he met along the shore, retire to his boat, and buy what they brought in late that day. Many blacks here keep snakes in captivity, but seldom show them to strangers.

PORT-AU-PRINCE, HAITI

Museum

HERPETOLOGICA

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by

ALBERT G. SMITH

LOYOLA UNIVERSITY

CHICAGO

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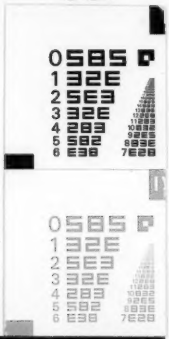
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